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(G) Toward radiotherapy dose planning for cervical brachytherapy procedures using three-dimensional ultrasound images

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Brachytherapy is a type of radiation therapy typically used in the treatment course of cervical cancer. During brachytherapy, highly radioactive sources are placed within the patient using specialized applicators or needles. While the applicators are inserted under the guidance of two-dimensional (2D) ultrasound (US), computed tomography (CT) or magnetic resonance (MR) imaging is subsequently used to localize the applicator and plan the radiation dose. These modalities excel at confirming applicator placement and the surrounding anatomy, however, they are costly and inaccessible to underfunded healthcare centers. Our group has previously developed a three-dimensional (3D) US system that acquires volumetric images of the female pelvis during the applicator insertion procedure to overcome these limitations. We now propose the use of 3D US images as a viable dose planning modality. As such, this feasibility study examined two different brachytherapy applicators within anthropomorphic female pelvic phantoms. Both phantoms were individually imaged with the 3D US system and offline contours of the target volume and nearby organs-at-risk (OARs) were completed by two trained observers. Intra- and inter-user variability statistics were obtained for the contours to assess user reliability. The applicators were digitized within our treatment planning system and a 3D US radiotherapy plan was developed. Simultaneously, conventional CT dose plans were developed on the same phantoms following our clinical protocol. The two sets of plans were then compared to ascertain the efficacy and clinical relevance of our proposed 3D US approach. Our preliminary results indicate that the 3D US plans meet the primary objectives of our clinical protocol for dose to the target volume as well as OARs. Our future work involves performing 3D US-based radiotherapy plans on patient images, for which a clinical trial is currently in progress. This work has the potential to enhance the accessibility and affordability of cervical brachytherapy procedures.

Keyword-1

Radiotherapy

Keyword-2

Three-Dimensional Ultrasound

Keyword-3

Dose Planning

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